Claims

1. A tunnel diode in which the collector comprises a band gap material, said band gap material being a crystal material having filled zero temperature valence band and empty conductive band.

2. The tunnel diode of claim 1 additionally comprising an emitter coated with a layer of a band gap material.

3. The tunnel diode of claim 1 or claim 2 in which the collector comprises a layer of band gap material deposited on a metal collector.

4. The tunnel diode of claim 3 in which said layer of material has a thickness greater than the mean distance of relaxation of electrons tunneling from said emitter.

5. The tunnel diode of any of the preceding claims in which the band gap material is selected from the group consisting of: a semiconductor, a hetero-structured semiconductor, a dielectric, a diamond material, an alkali metal oxide and an alkaline earth oxide.

6. The tunnel diode ofany of the preceding claims in which the band gap material is selected from the group consisting of: Ge, Si, GaAs, SiC and AlGaAs.

7. The tunnel diode of any of the preceding claims in which the electrodes are separated by a gap in the range 1 - 100nm.

8. The tunnel diode of claims 1 to 6 in which the electrodes are separated by a gap in the range 1 - 10nm.

9. The tunnel diode of claims 1 to 6 in which a gap between the emitter and collector electrodes is evacuated.

10. A vacuum diode heat pump comprising the tunnel diode of any of the preceding claims.

11. A heat to electricity converter comprising the tunnel diode of claims 1 to 9.

12. A method for promoting the tunneling of electrons having an energy level higher than the Fermi level from an emitter surface, comprising the step of positioning a collector comprising a band gap material at a distance within the tunneling range of said electrons, said band gap material being a crystal material having filled zero temperature valence band and empty conductive band.

13. A method for preventing back tunneling of electrons in a tunnel diode comprising the step of coating a collector with a layer of a band gap material, said band gap material being a crystal material having filled zero temperature valence band and empty conductive band.

14. The method of claims 12 and 13 in which the collector comprises a layer of band gap material deposited on a metal collector.

15. The method of claim 14 in which said layer of material has a thickness greater than the mean distance of relaxation of electrons tunneling from said emitter.

16. The method of claims 12 to 15 in which the band gap material is selected from the group consisting of: a semiconductor, a hetero-structured semiconductor, a dielectric, a diamond material, an alkali metal oxide and an alkaline earth oxide.

17. The method of claims 12 to 15 in which the band gap material is selected from the group consisting of: Ge, Si, GaAs, SiC and AlGaAs.

18. The method of claims 12 to 17 in which the electrodes are separated by a gap in the range 1 - 100nm.

19. The method of claims 12 to 15 in which the electrodes are separated by a gap in the range 1 - 10nm.

20. The method of claims 12 to 15 in which a gap between the emitter and collector electrodes is evacuated.